Azaira, alhetma: two medieval arabisms reflecting the allocation of irrigation water

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The techniques of irrigation that Arabs and Berbers brought to the Iberian peninsula included not only mechanical devices, such as water-lifting machines like the *shadūf* and noria, or water capture techniques like the *qanāt*, but also —in the same "package" of techniques— institutional arrangements for apportioning or delivering water. Such arrangements although, in a sense, purely mental phenomena, are *technological* because they are instruments of resource allocation in exactly the same way as are physical devices of water distribution, like diversion dams (*azudes*) and divisors (Castilian, *partidores*, structures that transform abstract measurements of water into real proportions).

Irrigation systems in the Huecha River valley of Aragón present two common features of North African irrigation, documented from Morocco to the Nile Valley.[1] The first is that irrigation turns were structured by the

[1] The documents here cited, many of which have been published, are from the Monastery of Veruela, the predominant seigneurial landholder in the Upper Huecha Valley, whose archive is now preserved in the Archivo Histórico Nacional, Madrid. On Huecha River irrigation systems, see S. Teixeira, *El dominio del Monasterio de Veruela: la gerencia de un espacio agrario andalusí*, microfiche ed., (Barcelona, Universitat Autònoma, 1995); "A transformação do espaço agrário irrigado andalusí a partir da conquista feudal: o domínio do Mosteiro da Veruela," in *Anais, II Jornada de Trabalho do Laboratório de Análise do Proceso Civilizatório: Tempo e Espaço: a construção da História Regional* (Campos dos Goytacazes, 1997), pp. 97-105; and "O sistema hidraulico do Vale do Huecha sob o domino do mosteiro de Veruela (Aragão)," *I Congreso de Arqueologia Peninsular* (Oporto, 1993), pp. 383-402. On measurement and allocation systems of Andalusī origin in relict peninsular irrigation systems, see T. F. Glick and H. Kirchner, "Hydraulic Systems and Technologies of Islamic Spain: History and Archaeology," in P. Squatriti, ed., *Working with Water in Medieval Europe* (Leiden, Brill, 2000), pp. 267-329.

canonical times of prayers, particularly the noonday prayer (*ẓuhr*) and that of mid and late-afternmoon (*ʿaṣr*). Because the times of daytime prayer were determined by the position of the sun and the length of shadows cast, irrigation time was frequently calibrated by the length of a man's shadow, in feet. All these associations appear in the Huecha Valley.

In a settlement charter granted by the Monastery of Veruela in 1238 to Alcalá de Moncayo, a village (*alqueria*) associated with a *ḥiṣn*, whose original irrigated space was located on alluvium next to the bed of the river, a irrigation turn or segment of it, is called an *azaira* (sometimes *zaiara*), a term hitherto unexplained.[2] This is an Arabism from *ẓahīra* ("midday"), or its referent in irrigation, the afternoon watering corresponding to the *ẓuhr*. Thus, among the Gaʿaliyyīn, Arab noria farmers from Taragma el Ghaba, Sudan, the *ẓuhurāwi* watering was the afternoon turn, from 12 to 18:00.[3] Unlike the Taragma usage, however, *azaira* in the Upper Hueche Valley meant *any* three or four hour bloc of time in irrigation turn, without respect to the time of day. This parallels a common usage in North African irrigation systems where, however, not the *ẓuhr*, but the following prayer time, the *ʿaṣr*, has become the generic irrigation turn. Thus in the oasis of El Guettar, near Gafsa, Tunisia, *ʿaṣr* has been converted into a measure of irrigation water four hours in length, with six *aʿṣār* in a period of twenty-four hours.[4] Likewise, irrigation time is widely measured in Morocco by the canonical prayer intervals following the position of the sun, but the generalization of *ʿaṣr* to mean

[2] M. L. Ledesma Rubio, *Cartas de población del Reino de Aragón de los siglos medievales* (Zaragoza, 1991), p. 311: *açayra, çayara*. Angel González Palencia derives *azaira* from *sir* (or *sair*), course, period; "Notas sobre el régimen de riegos en la región de Veruela en los siglos XII y XIII," *Al-Andalus*, 10 (1945), 79-88, on p. 85 note 6. He most likely was following R. Dozy, *Supplément aux dictionnaires arabes*, 2 vols. (Leiden, Brill, 1927), I, 712.

[3] Christian Delmet, "Le systeme traditionnel d'irrigation chez les arabes Gaᶜaliyin Taragma (Soudan)," *Techniques et Culture*, 8 (1986), 19-109, on p. 98. The *ẓuhr* extends from "the time when the sun begins to decline till the time when shadows are of equal length with the objects by which they are cast": D. A. King, "Mīḳāt," *Encyclopaedia of Islam*, new ed (Leiden, Brill, 1960--), VII, 25-32, on p. 27.

[4] P. Nouailhac, "L'eau et les problemes hydrauliques dans les oasis de Gafsa," typescript (n.p., n.d.), p. 30 (*açeur*); G. Bédoucha, "The Watch and the Waterclock: Technological Choices/Social Choices," in P. Lemonnier, ed., *Technological Choices: Transformation in Material Cultures Since the Neolithic* (London, 1993), pp. 77-107, on pp. 91, 98-99.

any such interval appears to be specifically Tunisian.[5] We suggest that the *ẓuhr*, another canonical prayer period may have undergone a similar extension of meaning

On the medieval Huecha river, *açafra*, *çafra*, or *azafra* had the same meaning in the Lower Valley, in Magallón and Mazalcorag, as *azaira* had in the Upper Valley. Some authors have attempted to derive *azafra* from *safra*, a journey or trip.[6] It seems to us, however, that *azafra* and *azaira* are both variants derived from *ẓahīra*, the replacement of the Arabic aspirate *h* by *f* having been quite common in medieval Castilian and Aragonese.[7]

The *azaira/azafra* was the standard turn in which irrigation rights were apportioned. But some parcels had rights in special turns that distributed excess water in April and May only. This special turn was called *alhetma*, as in the *alhetma* of April, or the *alhetma* of a specific village (in the sense of the day or days when the village has the right to irrigate).[8] This term and its variant, *alema*, have been discussed for more than a century, the

[5] J. Chiché, "Description de l'hydraulique traditionelle," in N. Bouderbala, *et al.*, *La question hydraulique: Petite et moyenne hydraulique au Maroc* (Rabat, 1984), pp. 199-319, on p. 247; E. Blanco Izaga, *El Rif, 2a parte, La ley rifeña, II, Los cánones rifeños comentados* (Ceuta, 1939, reprinted in V. Moga Romero and A. Bravo Nieto, eds., *Emilio Blanco Izaga, coronel en el Rif* (Melilla, 1995), p. 108. Prayer-interval timing is apparent in many Spanish successor systems; see, e.g., L. Cara Barrionuevo, "Las aguas del Maimón (Los Vélez, Almería): Continuidad y cambio histórico en un espacio hidráulico tradicional," *Revista Velezana*, no. 11 (1992), 15-26, on p. 21. Cara (p. 25) believes the irrigation systems of Los Vélez to be similar to those of Touzer, a Tunisian oasis.

[6] J. Corominas, *Diccionario crítico etimológico castellano e hispánico*, 6 vols. (Madrid, Gredos, 1980-91), VI, 34-36, s.v. *zafra*, is inconclusive, confusing and conflates several similar-sounding words.

[7] Thus one finds alternating forms like Alhambra/Alfambra, or *alholí/alfolí*; see Rafael Lapesa, *Historia de la lengua española*, 9th ed. (Madrid, Gredos, 1981), p. 142. In a generous and learned comment on an earlier draft of this paper, Federico Corriente prefers *safra* "viaje, vez" both on semantic grounds and that, in Romance, the *ẓ* is never transcribed with *z*, but with a *d* or *t* in such an intervocalic position. We respond that *ẓahīra* is more within the logic of North African usage- a period of time reducible to 3 or 4 hours in a 12 or 24-hour turn. Local customs such as these have a way of eluding easy identification, but still must owe their origin to some specific immigrant group.

[8] *Alhetma de aprile* (González Palencia, *loc. cit.*); *alhetma de Maçalcoras* (*ibid.*, p. 84). In Granada, the term *dula* is used in the same way, to denote a bloc of irrigation time, a turn, or a specified portion thereof.

proposed etymologies adding up to a series of wild guesses.[9] F. Corriente's recent solution to the problem is equally mistaken. Following E. Terés, he says *alhetma* is a variant of *alema*, irigation turn, from *alxidma* (classical Arabic, *khidma)*, "servicio", an etymology which "leaves no doubt," discrediting the solutions of Dozy, Corominas, and the *Diccionario de la Real Academia Española*, "phonetically impossible and semantically improbable." [10] In fact the etymology is both obvious and unproblematic, from *al-khaiṭ mā'*, "thread of water" (Castilian, *hilo*; Valencian, *fila*, two common translations of the Arabic term, semantically identical).[11] This time there really is no doubt, neither on semantic grounds nor on phonetic ones, as demonstrated in the related hydronym, Alfeitami, "the two threads of water", a philologically well-documented irrigation canal in the Lower Segura basin.[12]

[9] González Palencia, *ibid.*, p. 84, note 2, where he derives the term from *al-ḥiṭma*, section, fragment; *Diccionario Histórico de la Lengua Española*, fasc. 13, s.v. *alhetma*, proposed derivation from *al-ḥiṭma*, following González Palencia; Corominas, *Diccionario*, I, 166: from al-*ḥima* "something prohibited." See also, J. Yanguas y Miranda, *Diccionario Histórico-Político de Tudela* (1823; 2nd.ed., 1828), s.v. *Alhema*. More recently, B. Pavon Maldonado, *Tratado de arquitectura hispanomusulmana, I: Agua* (Madrid, CSIC, 1990), p. 232, also is mistaken: "alhema -del árabe al-amma [*al-'āmma*], alema- porción de agua de regadío que se reparte por turno en días." The definition is correct; the etymology (following the *Diccionario de la Real Academia Española*) is not.

[10] F. Corriente, *Diccionario de arabismos y voces afines en iberorromance* (Madrid, Gredos, 1999), p. 149. Appeals to semantics, it seems clear to us, are all too frequently in the eye of the beholder.

[11] The appositive form, *al-khaiṭ mā'*, where in classical Arabic one would expect *khaiṭ al-mā'*, is well documented in Andalusi Arabic by Corriente, *Arabe andalusí y lenguas romances* (Madrid, 1992), p. 109, who gives numerous examples, e.g., *al-walad zinā*, "bastard" (literally, child of fornication); *al-ghars karm*, "vineyard" (plant of the vineyard), *al-burj ḥamām*, "dovecote" (tower of the dove/s).

[12] Alfeitami (with variant spellings Alfaitani, Alfayteni) village and irrigation canal in Orihuela. According to C. Barceló Torres, *Toponimia arábica del País Valencià. Alqueries i castells* (Xàtiva, 1983), p. 237, "probablement ve de l'àrab *al-khayṭān*, "les dues files d'aigua." Derivation from the dual is correct here because the Alfeitami canal divides, right below its diversion dam, into two equal main canals: the Acequia del Río and the Acequia de Almoradí. Corriente's view (personal communication, January 31, 2002) is: "Con respecto a *alhetma*, los autores han estado mucho más finos, ya que dan buenos argumentos lingüísticos y semánticos, aunque no hayan visto la cita de Alcalá en mi DAA, p. 179, *kait min mi* "corriente venaje de agua", favorable a su propuesta, que va a convencer a muchos, por lo ingeniosa y sensata. A mí casi me convence, pero no las tengo todas conmigo, porque no están resueltas las dificultades fonéticas y semánticas. No veo ninguna dificultad semántica en que se llame "servicio" al período atribuido de

The water measurement or delivery unit in the Huecha Valley was the *azumbre*, a common Arabism from *ṯumn*, one-eighth: thus, in an Arabic document from Veruela: "one-eighth part of water" — *al-ṯumn wāhid min al-mā'*. The Latin usage is similar: "Et est isto açumen de aqua in illa alfetma de Maçalcoras" (one-eighth of water in the *alfetma* of Mazalcorag).[13] As a water measure the *azumbre* corresponded originally to one-eighth of a day, or three hours.[14] Since the actual measurement corresponded to a period of unequal hours determined by shadows, however, the four-hour value of an *'aṣr* and the three of a *ṯumn* might well have been interchangeable in customary usage. A mid-twelfth century document describes a right to one azumbre of water from *alazer* (here, in the original canonical sense of *'aṣr*) to nightfall, a period which, in the summer, might amount to as many as six hours.[15] Another, from 1286, reveals unequal hours still measured by Christians according to Islamic canonical prayer times: "et es in braço que pertiene donna Sancha quando cayer de dia es del Alazar entro al sol puesto de nueyte de gallo al sol ixient." That is, Sancha has the right to water in her channel, when (her turn) is in daytime, from *al- 'aṣr* until sunset. (When her turn is at night, it

uso del agua, y sí en que se llame "hilo de agua" a un turno especial concedido en atención a la abundancia de caudal en primavera y, desde el punto de vista lingüístico, extraña la falta de *imālah* (cf. *betalmé* "letrina"): claro está que hay arabismos tempranos y septentrionales sin *imālah* (vgr., *fulano*), pero eso choca con la estructura semántica *alhayt má, de registro bajo y tardío. También el acento se esperaría agudo, como en *betalmé*."

[13] González Palencia, "Veruela", pp. 79-80, 84.

[14] As, for example, in Novelda, where the *azumbre* was the equivalent of an hour and a half of water; see T. F. Glick, *Irrigation and Society in Medieval Valencia* (Cambridge, Harvard University Press, 1970), p. 215. In the Veruela documents, the time value of the *ṯumn/azumbre* was three hours. In Novelda, the water has been "doubled" (the time-unit is halved, so that twice the water, per unit of delivery, is supplied). For the etymology of *azumbre*, see Glick, *Irrigation and Society*, p. 34 note 29

[15] González Palencia, "Veruela," p. 85: "In Roblat in illa aqua bel Brazo de Pol una *azumne* de *alazer* usque ad nocte." The actual time period could have been either three or four (unequal) hours. There is a variant spelling, *alaxar*, which J. A. Sesma *et al.*, identify as *al-a'šar*, plural of 'ušr, "tenth:" "Regadíos andalusíes en el vallemedio de Ebro: El ejemplo del Río Aguasvivas," in *II Coloquio Historia y Medio Físico. Agricultura y regadío en al-Andalus* (Almería, Instituto de Estudios Almerienses, 1996), pp. 67-84, on p. 81. We believe our solution to be more likely on semantic as well as phonological grounds.

extends) from the cock's crow until sunrise.[16] Note that daybreak (that is, when the cock crows) is reckoned at around halfway through the night, well before sunrise.[17]

The second common feature of North African irrigation is the determination of irrigation time by shadows. The four daytime *a'ṣār* in El Guettar are determined by the shadow cast by a man, the first from sunrise until the shadow reaches a length of 12 feet to the west, the second from the 12-foot shadow until midday, when the sun is at the vertical, etc. Shadow measurements are pretty much universal in North Africa, in Tunisia, as well as Morocco.[18] Shadow measurement was also used in some of Veruela's possessions on the Huecha River, with the same values as in the case of El Guettar —e.g., a turn described (in 1199) as extending de "xii pedes de illa aqua...usque ad medium diem."[19] Shadow measurement, expressed in feet (*peus*) still survives in the irrigation operations of Albaida (Valencia), in an irrigation turn between Atzeneta (< Zanāta) and El Rafalet. The author of a recent study associates this practice with that of el-A'nad, Tunisia.[20] But measuring irrigation time by prayer intervals determined by shadow measurement was common throughout the Islamic world, in Berber Ifrīqiya as well as in the Yemen.

[16] Archivo Histórico Nacional, Clero/Veruela, Carpeta 3.768, perg. 12. Cf. Chiché, "Hydraulique traditionelle," p. 249, where turns the irrigation day at Imallul "est rythmée en *çubh'*, *'aṣr*, *dh'a*, midi, *'aṣr*, *mar'rab*, *'aša* et *mint* chant du coq."

[17] King, "Mīḳāt," p. 27.

[18] Chiché, "Hydraulique traditionelle," p. 249; Bédoucha, "Watch and Waterclock," p. 91.

[19] Literally, "twelve feet of that water...till noon."Archivo Histórico Nacional, Madrid, Codex 995B, fol. 49: Agreement between the Monastery of Veruela and Farag de Alhazin and his brothers. This time bloc was a unit in a springtime irrigation turn (*alhetma*): xii pedes de illa aqua de illas alhetmas illa medietate de illa aqua qui fuerit et uenerit in illa cequia de april et de madio, usque ad medium diem". The precise time value of an *'aṣr* measured by shadows would vary by latitude and, over the course of a year, the declination of the sun. See W. H. King, "Irrigation in the Dakhla Oasis," *Geographical Journal*, 50 (1917), 358-364, on pp. 361-362. Dakhla is an oasis in eastern Libya.

[20] A. Soler, "Regadiu, toponímia i poblament islàmic a la conca alta del riu d'Albaida" in *750 anys com a Valencians: Albaida i la Vall 1245-1995* (Ontinyent, 1995), pp. 27-91, on pp. 87-90, and Joan Olivares, "Rellotges de sol: Ombres del passat," in *Mètode: Revista de Difusió de la Investigació* (Valencia), 26 (Summer 2000), 7-11.

Similar measurement systems —past and present— elsewhere in Spain will no doubt be identified in the future.

The package of terminology, operating procedures, and measurement systems we have described is consistent with North African Arab and Berber irrigation practices generally and with those of Tripolitania in particular. These practices do not appear by chance, but were put in place by immigrants who brought to the peninsula concepts of water allocation from their places of origin. Their documented presence can be viewed, therefore, as a corroboration of M. Barceló's assertion of the importance of Tripolitanian settlement in the Ebro Valley.[21]

[21] M. Barceló, "Aigua i assentaments andalusins entre Xerta i Amposta (s. VII-XII)," *II Congreso de Arqueología Medieval Española*, 3 vols. (Madrid, 1987), 2: 413-420.